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INVENTOR(S): ERNEST B. RENNELLS

TITLE: SATELLITE RADIO REAL TIME TRAFFIC UPDATES

ATTORNEYS: ANTHONY LUKE SIMON, ESQ.
GENERAL MOTORS CORPORATION
LEGAL STAFF
MAIL CODE: 482-C23-B21
300 RENAISSANCE CENTER
P.O. BOX 300
DETROIT, MICHIGAN 48265-3000
(313) 665-4714

SATELLITE RADIO REAL TIME TRAFFIC UPDATES

FIELD OF THE INVENTION

The invention relates to management of data transmission over a wireless communication system. More specifically, the invention relates to a method and system for providing real-time traffic updates to a mobile vehicle.

BACKGROUND OF THE INVENTION

Many passenger vehicles now incorporate an integrated communication system. A Vehicle Communication Unit (VCU) used in conjunction with a Wide Area Network (WAN) such as a cellular telephone network or a satellite communication system allows for a variety of fee-based subscription services to be provided in a mobile environment. The VCU is typically a mobile vehicle communication device including a cellular radio, satellite transceiver and global positioning capabilities. Communication through a carrier service may be initiated at the VCU at turn-on or through manual or voice command phone number entry. A radio communication link is established between the VCU and a Wide Area Network (WAN) using a node of the WAN in the vicinity of the VCU.

In cellular telephone systems, a node is commonly referred to as a "cellular base station." Once the radio communication link between the VCU and the cellular base station has been established, the base station then utilizes a combination of additional cellular base stations, land line networks, and possibly satellite systems to connect the VCU to the dialed telephone number.

Some VCU devices additionally incorporate a satellite radio receiver for receiving data such as global positioning system (GPS) location data, digital radio broadcasts and other data for various subscription services. A satellite transceiver system implemented in a VCU usually has a limited data throughput, but in practice is typically used just for receiving data from a central server, rather than for a two-way communication. A satellite radio broadcast may provide the same data simultaneously to many clients for a subscription service in a much more efficient manner than a cellular network, for example. However, the maximum bandwidth of a satellite system limits the amount of data that may be broadcast to a vehicle in real-time and still be processed without compromises in system response times.

In many urban regions where subscribers of fee-based services reside, there are significant traffic incidents. In many cities, the only traffic information available is provided by a traffic-news radio station broadcast, often delivered live from a helicopter-based reporter. However, some large metropolitan municipalities have installed electronic monitoring devices in roadbeds and near roadways to track traffic density and other traffic congestion metrics, although such electronic monitoring systems are usually not able to provide other real-time traffic information such as accident and stalled vehicle location reports Radio reports may be infrequent or may not concern the section of city or roadway where a driver is actually driving, preventing practical real-time traffic updates for many commuters. It would be desirable, therefore, to provide a method and system for real-time traffic updates to a vehicle that would overcome these and other disadvantages.

SUMMARY OF THE INVENTION

The present invention is directed to a method for providing real-time traffic updates to a mobile vehicle communication device that includes producing traffic incident region coordinate data, communicating the traffic incident region coordinate data to a mobile vehicle communication device, and determining when a traffic incident region coordinate is within a predetermined radius around the mobile vehicle communication device.

In accordance with another aspect of the invention, a system for providing real-time traffic updates to a mobile vehicle communication device includes means for producing traffic incident region coordinate data, means for communicating the traffic incident region coordinate data to a mobile vehicle communication device, and means for determining when a traffic incident region coordinate is within a predetermined radius around the mobile vehicle communication device.

In accordance with yet another aspect of the invention, a computer readable medium is provided. Computer readable code is provided for producing traffic incident region coordinate data, for communicating the traffic incident region coordinate data to a mobile vehicle communication device; and for determining when a traffic incident region coordinate is within a predetermined radius around the mobile vehicle communication device.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an exemplary operating environment according to an embodiment of the invention;

FIG. 2 is a block diagram of a global positioning system receiver which may be employed with an embodiment of the invention;

FIG. 3 is a block diagram of a mobile vehicle communication device which may be employed with an embodiment of the invention;

FIG. 4 is a block diagram of a server system for producing traffic region coordinate points in an embodiment of the invention;

FIG. 5 is an illustration of traffic data regions in accordance with an embodiment of the present invention;

FIG. 6 is an illustration of a forward view radius in accordance with an embodiment of the present invention;

FIG. 7 is a flow diagram of a method for providing real-time traffic updates to a mobile vehicle communication device; and

FIG. 8 is a process flow diagram in an example of the method of FIG. 7 according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT

FIG. 1 is a block diagram of an exemplary operating environment according to an embodiment of the present invention. FIG. 1 shows an embodiment of a system for operating a satellite radio subscription service and a wireless communication service in a mobile vehicle, in accordance with the present invention, and may be referred to as a mobile vehicle communication system (MVCS) **100**. The mobile vehicle communication system **100** includes one or more mobile vehicle communication units (MVCU) **110**, one or more audio devices **115**, one or more wireless communication systems **120**, one or more radio carrier systems **130**, one or more satellite broadcast systems **140**, one or more communication networks **150**, one or more land networks **160**, and one or more service providers **170**.

In one example, MVCS **100** is implemented as an OnStar ® system, as is known in the art, and available from the OnStar division of General Motors Corporation based in Troy, Michigan, with regards to wireless communications, and as an XM Satellite Radio ® system, as is known in the art, and available from XM Satellite Radio, Inc., of Washington, DC with regards to satellite radio and terrestrial digital radio communications.

MVCU **110** includes a wireless vehicle communication device (module, MVCS module) such as an analog or digital phone with suitable hardware and software for transmitting and receiving data communications. In one embodiment, MVCU **110** further includes a wireless modem for transmitting and receiving data. In another embodiment, MVCU **110** includes a digital signal processor with software and additional hardware to enable communications with the mobile vehicle and to perform other routine and requested services.

In yet another embodiment, MVCU **110** includes a global positioning system (GPS) unit capable of determining synchronized time and a geophysical location of the mobile vehicle. In operation, MVCU **110** sends to and receives radio transmissions from wireless communication system **120**. MVCU **110** may also be referred to as a mobile vehicle communication device throughout the discussion below.

Audio device **115** includes hardware suitable for receiving broadcast signals within MVCU **110**. In one embodiment, audio device **115** includes a receiver and receives broadcasts from wireless communication system **120**, radio broadcast system **130**, and satellite broadcast system **140**.

In another embodiment, audio device **115** further includes a medium for storing programming information. In an example, the programming information includes customer requested programs supplied by one or more providers including various formats. Formatted programs may include “Talk Radio,” various music genres, targeted regional information, and the like. In another example, the customer requested programs are provided in the form of packages and referred to as a satellite radio program subscription (SRPS).

In yet another embodiment, audio device **115** further includes an audio speaker, a synthesized voice output, an audio channel, or the like. In one example, audio device **115** includes headphones, a television receiver, and a display device.

In another embodiment, MVCU **110** includes a speech recognition system (ASR) module capable of communicating with audio device **115**. In yet another embodiment, the module is capable of functioning as any part of or all of the above communication devices and, for another embodiment of the invention, may be capable of data storage, data retrieval, and receiving, processing, and transmitting data queries. In one example, audio device **115** includes a speech recognition system (ASR) module.

Wireless communications system **120** is a wireless communications carrier or a mobile telephone system and transmits to and receives signals from one or more MVCU **110**. Wireless communication system **120** incorporates any type of telecommunications in which electromagnetic waves carry signal over part of or the entire communication path. In one embodiment, wireless communication system **120** is implemented as any type of broadcast communication in addition to those of radio broadcast system **130** and satellite broadcast system **140**. In another embodiment, wireless communications system **120** is implemented as a single unit in conjunction with radio broadcast system **130**. In another embodiment, wireless communications system **120** is implemented via coupling with radio broadcast system **130**, or in some such other configuration as would allow the systems to function as described.

In one example, such wireless communication carrier is a short message service, modeled after established protocols such as IS-637 SMS standards, IS-136 air interface standards for SMS, and GSM 03.40 and 09.02 standards. Similar to paging, an SMS communication could be broadcast to a number of regional recipients. In another example, the carrier uses services compliant with other standards, such as, for example, 802.11 compliant systems and Bluetooth systems.

In another example, the mobile telephone system may be an analog mobile telephone system operating over a prescribed band nominally at 800 MHz. The mobile telephone system may be a digital mobile telephone system operating over a prescribed band nominally at 800 MHz, 900 MHz, 1900 MHz, or any suitable band capable of carrying mobile communications.

Radio broadcast system **130** transmits radio signals with data to audio device **115** within MVCU **110.** In one embodiment, radio broadcast system **130** transmits analog audio and/or video signals. In an example, radio broadcast system **130** transmits analog audio and/or video signals such as those sent from AM and FM radio stations and transmitters, or digital audio signals in the S band (approved for use in the U.S.) and L band (used in Europe and Canada).

In another embodiment, audio device **115** stores or retrieves data and information from the audio and/or video signals of radio broadcast system **130**. In an example, audio device **115** retrieves terrestrial digital radio signals from a signal received from radio broadcast system **130**.

Satellite broadcast system **140** transmits radio signals to audio device **115** within MVCU **110**. In one embodiment, satellite broadcast system **140** may broadcast over a spectrum in the "S" band (2.3 GHz) that has been allocated by the U.S. Federal Communications Commission (FCC) for nationwide broadcasting of satellite-based Digital Audio Radio Service (DARS). In an example, satellite broadcast system **140** may be implemented as XM Satellite Radio®.

In operation, broadcast services provided by radio broadcast system **130** and satellite broadcast system **140** are received by audio device **115** located within MVCU **110**. Broadcast services include various formatted programs based on a package subscription obtained by the user and managed by the audio device **115** and referred to above.

Communications network **150** is implemented as any suitable system or collection of systems for connecting wireless communications system **120** to at least one MVCU **110** or to a service provider **170**. In one embodiment, communications network **150** includes a mobile switching center and provides services from one or more wireless communications companies.

Land network **160** connects communications network **150** to service provider **170**. In one embodiment, land network **160** is implemented as a public-switched telephone network, a wired network, an optical network, a fiber network, another wireless network, or any combination thereof. In an example, land network **160** includes an Internet protocol (IP) network. In another embodiment, an MVCU **110** utilizes all or part of the wireless communications system **120**, communications network **150**, and land network **160**.

In yet another embodiment, land network **160** connects one or more communications systems **120** to one another. In another embodiment, communication network **150** and land network **160** connect wireless communications system **120** to a communication node or service provider **170**.

Service provider **170** is implemented as one or more locations where communications may be received or originate to facilitate functioning of the mobile vehicle communication system (MVCS) **100**. Service provider **170** may contain any of the previously described functions.

In one embodiment, service provider **170** is implemented as a call center, as known in the art. In an example, the call center is implemented as a voice call center, providing verbal communications between an advisor in the call center and a subscriber in a mobile vehicle. In another example, the call center is implemented as a voice activated call center, providing verbal communications between an ASR unit and a subscriber in a mobile vehicle. In yet another example, the call center is implemented as a virtual call center, providing virtual communications between a virtual advisor and a user interface. In another embodiment, the call center contains any of the previously described functions.

In an example, the call center is implemented to service an OnStar® system. In another example, the call center is implemented to service an XM Satellite Radio ® system. In yet another example, the call center is implemented to service one or more of the above examples, or other services.

In operation, a service provider **170** utilizes one or more portions of the aforementioned communications network to communicate subscriber requested programming to audio device **115**. The subscriber requested programming may then be accessed by audio device **115** utilizing one or more radio broadcast system **130** and satellite broadcast system **140** segments. In one embodiment, a subscriber receives substantially real-time traffic incident alert data that characterizes multiple traffic incident regions having one or more traffic incidents, so that specific traffic incident data may be received for the subscriber's geographic location based on monitoring the received traffic region coordinates.

FIG. 2 is a block diagram of a global positioning system receiver which may be employed with an embodiment of the invention. FIG. 2 illustrates components utilized in receiving, decoding, and implementing a GPS signal according to one embodiment of the present invention.

In FIG. 2, GPS receiver **200** includes antenna **280**, preamplifier **220**, mixer **230**, demodulator **240**, access code generator **250**, clock **260**, and receiver processing unit **270**. In one embodiment, GPS receiver **200** is implemented as part of MCVS **100** described in FIG. 1 above. In another embodiment, GPS receiver 200 is implemented in conjunction with a server system discussed in reference to FIG. 4.

In FIG. 2, antenna **280** is coupled to preamplifier **220**. Preamplifier **220** is further coupled to mixer **230** and clock **260**. Mixer **230** is further coupled to demodulator **240** and access code generator **250**. Demodulator **240** is further coupled to access code generator **250** and receiver processing unit **270**. Access code generator **250** is further coupled to clock **260** and receiver processing unit **270**. Clock **260** is further coupled to receiver processing unit **270**.

Antenna **280** is a GPS signal reception device suitable for receiving a GPS signal, as is known in the art. In one embodiment, the antenna **280** utilized is designed to receive a 1.5 GHz signal. Preamplifier **220** is a hardware component that receives the GPS signal from antenna **280** and a clock signal from clock **260**. Preamplifier **220** amplifies and converts the received GPS signal to a frequency and magnitude suitable for sampling. Preamplifier **220** may be implemented as any suitable preamplifier/converter component, as is known in the art.

Mixer **230** is a hardware component that receives the amplified/converted signal from preamplifier **220** and a civilian access code measurement from access code generator **250**. Mixer **230** provides a reference frequency utilized by GPS receiver **200** to correlate the transmitted signal. In one embodiment, mixer **230** provides a Doppler Frequency Measurement (DFM). Mixer **230** may be implemented as any suitable mixing component, as known in the art.

Demodulator **240** is a hardware component that receives the reference signal produced by mixer **230** and produces a navigation message and a code control message. Demodulator **240** transmits the navigation message to receiver processing unit **270** and further transmits the code control message to access code generator **250**. Demodulator **240** may be implemented as any suitable demodulating component, as known in the art.

Access code generator **250** is a hardware component that receives the code control message from demodulator **240** and a clock signal from clock **260**. Access code generator **250** generates the civilian access code measurement allowing synchronization and decoding of the received GPS signal. Access code generator **250** transmits the civilian access code measurement to mixer **230** and receiver processing unit **270**. In one embodiment, access code generator **250** is implemented as a type of shift register. In one example, access code generator **250** is implemented as a linear feedback shift register (LFSR).

Clock **260** is a hardware component that produces a clock measurement, also referred to as the clock signal, utilized for synchronous timing of GPS receiver **200**. Clock **260** transmits the clock signal to preamplifier **220**, access code generator **250**, and receiver processing unit **270**. In one embodiment, clock **260** is implemented as a reference oscillator providing a timing standard with which to synchronize access code generator **250**.

Receiver processing unit **270** is a hardware component capable of receiving data, analyzing the received data to determine positional location, and determining the validity of the analyzed data. Receiver processing unit **270** receives the navigation message from demodulator **240**, the access code measurement from access code generator **250**, and the clock measurement from clock **260**. Receiver processing unit **270** produces location information such as position, velocity, and the like, based on the received data.

In one embodiment, receiver processing unit **270** determines data bit alignment, data parity, and data decoding based on data received from demodulator **240**. In another embodiment, receiver processing unit **270** performs other determinations, such as, for example, satellite positions which may include raw measurement data, pseudo range correction which may include a satellite identifier utilized in conjunction with a lookup table/almanac, pseudo range, receiver position, velocity, and time computations based on data received from demodulator **240**, access code generator **250**, and clock **260**.

In yet another embodiment, receiver processing unit **270** produces a combination of the above described determinations based on defined program parameters. In one embodiment, such defined program parameters are determined by a manufacturer based on a service provider's determined needs.

Receiver processing unit **270** is additionally designed to store invalid data matching specified parameters, for transmitting to service provider **170** upon request. In one embodiment, receiver processing unit **270** is implemented as part of a central processing unit. In another embodiment, receiver processing unit **270** is implemented as a separate processing unit.

FIG. 3 is a block diagram of a mobile vehicle communication device which may be employed with an embodiment of the invention. FIG. 3 shows an MVCU **310** comprising an audio device **315**, a GPS receiver **300**, a processor **340** and data storage **350**. The audio device is shown further comprising a cellular transceiver **316** and a satellite receiver **317**. The data storage is shown further comprising a program **355** and stored data **356**. The audio device **315**, the data storage **350** and the GPS receiver **320** are shown operationally coupled to the processor **340**. An antenna **380** is further shown coupled to the MVCU **310**. MVCU **310** may comprise additional components (not shown) that are not relevant for an understanding of the present invention.

The audio device **315** is any audio device that provides communication functions as described in reference to audio device **115** of FIG. 1. In the present embodiment, audio device **315** is enabled to receive satellite radio broadcasts from a satellite transmitter such as satellite broadcast system **140** through satellite receiver **317** and for cellular radio communication through cellular transceiver **316**.

The GPS receiver **300** is any GPS device that provides global positioning data. In one embodiment, GPS system **300** is a device as described in reference to GPS receiver **200** of FIG. 2.

The processor **340** is any processor, microcontroller or combination of processors and microcontrollers that are enabled to communicate data between components, execute computer programs instructions, and provide command and control functions for audio device **315**. The processor **340** may comprise additional components (not shown) such as input-output ports, volatile or non-volatile memory and software modules.

The data storage **350** is any device for storing data, such as a disk drive, non-volatile memory and the like. Data storage **350** provides a database of stored data **356** for various types of data received to audio device **315** and GPS receiver **300**. Data storage **350** also provides storage for software modules such as program **355**. In one embodiment, program **355** is a program to monitor GPS traffic incident region GPS coordinate data received through GPS receiver **300** from a service provider, and initiate a communication to the service provider requesting localized traffic incident data, when a traffic incident GPS coordinate is received that is within a predetermined radial distance from the MVCU **310**. In another embodiment, MVCU **310** is coupled to a display device, a speaker system or both, and is enabled to provide received localized traffic incident data to a user in an audio or audiovisual format.

FIG. 4 is a block diagram of an exemplary computer system for producing traffic region coordinate points in an embodiment of the invention. FIG. 4 shows a computer system **400** comprising an I/O device **410**, a processor **420**, a user interface **430**, memory **440**, a display **450**, removable storage **460**, a bus **490**, and mass storage **470** comprising a database **475,** programs **476** and an operating system **477**. In FIG. 4 the I/O device **410**, the processor **420**, the user interface **430**, the memory **440**, the display **450**, the removable storage **460** and the mass storage **470** are all shown coupled to the bus **490**. The I/O device **410** is additionally shown enabled for communication external to computer system **400**. In one embodiment, computer system **400** is a server computer utilized by a service provider to compile and manage real-time traffic incident data for very large geographical areas that is broadcast via a satellite broadcast system **140** to traffic incident alert service subscribers.

The I/O device **410** is a device capable of bidirectional data communication with a device external to the computer system **400**. Examples of I/O devices include serial, parallel, USB, Ethernet and IEEE 802.11 compliant wireless devices, for example. In one embodiment (not shown) a GPS receiver is coupled to the I/O device **410** for receiving global positioning data, or for determining GPS coordinates based on traffic incident data.

The processor **420** is a computing device having memory and data control capability, such as caching and the like. The processor **420** may be integrated with supporting hardware such a video controller, a storage device controller and the like. Processor **420** executes instructions of a computer program such as program **476,** for example.

The user interface **430** is a device such as a keyboard, a mouse, a pointing device, a pen, a microphone or another device used to provide a data entry interface with a user of the computer system **400**.

The memory **440** is a hardware or virtual storage for computer code and data that the processor is manipulating. Memory **440** includes all dynamic memory external to the processor including video memory, additional cache memory and the like. Portions of mass storage **470** may also be used to provide virtual memory that may be used interchangeably with the memory **440**.

The display **450** is a visual display such as a CRT, LCD, plasma or projection display used to provide a user with a visual interface with the computer system **400**.

The removable media **460** is any device that provides a removable medium for storing computer code or data such as a magnetic disc drive, a writable optical disc drive or the equivalent.

The mass storage **470** is any device that provides storage for computer code and data such as a hard disk drive a recordable optical medium and the like. In one embodiment, the mass storage **470** is provided by a second computer server system over a network (not shown). The mass storage generally contains the operating system **477**, programs **476** and may include a database **475**. Programs include applications for execution by the computer system **400**. In one embodiment (not shown), the mass storage **470** is distributed over a very large network of computer systems that are linked together.

The bus **490** is a bidirectional communication device that enabled data communication between the various devices of computer system **400**. The bus may include a processor and other logic devices to enable multiple data clock speeds and protocols depending upon the connected devices.

In operation, computer system **400** runs programs such as program **476** for producing traffic incident region coordinate data to be stored in a database **475** and/or communicated to other devices through I/O device **410** such as a satellite broadcast system **140** as described in FIG. 1.

In one embodiment, one or more data entry operators enter traffic incident data into a database **475** in real-time for various geographic locations. Additional traffic incident data may be received electronically from various sources such as roadway sensors, GPS receivers **200**, and various municipal and police department computer systems. Program **476** compiles received traffic incident data, processes the incident data to group traffic incidents into a plurality of traffic incident regions, and then determines a traffic incident region GPS coordinate for each of the plurality of traffic incident regions. In one embodiment, the program **476** is configured to sort the various traffic incident data and group traffic incidents into traffic incident regions of a selected geometry and size, with each region having a single GPS coordinate in order to reduce the amount of traffic incident data that must be broadcast to the MVCU **310** of a traffic incident alert service subscriber.

FIG. 5 is an illustration of traffic data regions in accordance with an embodiment of the present invention. FIG. 5 shows three illustrative traffic data regions **500**, **501**, **502**. Traffic data region **500** is shown as a hexagonal region having four traffic incidents **525** and a traffic data region GPS coordinate **520**. Traffic data region **501** is shown as a hexagonal region bordering region **500** and having three traffic incidents **535** and a traffic data region GPS coordinate **530**. Traffic data region **502** is shown as a hexagonal region bordering both regions **500** and **501** and having four traffic incidents **545** and a traffic data region GPS coordinate **540**. In one embodiment of the present invention, the traffic incident regions illustrated in FIG. 5 are the result of a traffic incident data compilation and analysis process performed using a computer program such as program **476** of FIG. 4. The traffic data regions may have any suitable shape or size

In one embodiment, the traffic incident region geometry and size are determined through analytical and statistical methods to provide a suitable trade-off between parameters such as, but not limited to, precision of traffic incident data, bandwidth and availability of satellite broadcasting systems **140**, and number of traffic incidents per-unit-time. In another embodiment, traffic incident region size and geometry are selectable and variable depending on parameters such as those recited. For example, traffic incident density in rural regions is significantly reduced compared to traffic incident density in large metropolitan regions. Scaling the size of incident regions depending on traffic incident density yields a further reduction of necessary broadcast data.

In one embodiment, traffic incident regions such as regions **500**, **501**, **502** are contiguous regions of approximately five square miles that together cover a large geographical region, e.g., North America. In one embodiment, overlap of traffic incident region boundaries is provided for error correction and robustness.

In operation, a traffic incident region GPS coordinate is selected to represent a traffic incident region. In one embodiment, a traffic incident GPS coordinate is selected as the geometric center of a predetermined traffic incident region. In another embodiment, the traffic incident region GPS coordinate is selected using analytical processes based on the geographical location of traffic incidents within a predetermined traffic incident region. In yet another embodiment, a traffic incident region is defined based on the occurrence and location of traffic incidents within a predetermined or analytically determined proximity of each other. In yet another embodiment, a two dimensional iterative regression analysis provides a GPS coordinate representative of several traffic incidents that defines a traffic incident region. Selecting a single GPS coordinate to represent several traffic incidents within a region greatly reduces the amount of data that must be transferred to a traffic incident alert subscriber MVCU. When a traffic incident region GPS coordinate occurs within a predetermined "forward view" radius of the MVCU additional localized traffic incident data is requested.

FIG. 6 is an illustration of a forward view radius in accordance with an embodiment of the present invention. FIG. 6 shows a vehicle **600** having a "forward view radius" **640** defined by a sector of a circle **620** with a radius centered at vehicle **600** as determined by a GPS receiver **200**, and having sector angles defined by the angle of the forward view which is represented by two right triangles **610** and **611** perpendicular to the vehicle **600**. In one embodiment, the radial distance from the vehicle **600** that defines the "forward view radius" **640** is approximately 10 miles. In another embodiment, the radial distance from the vehicle **600** that defines the "forward view radius" **640** is controlled by a user of the system and may be set to any appropriate size as desired by the user. For example, in an embodiment using a user controlled forward view radius, one user may prefer a relatively small forward view radius and another user may prefer a relatively large forward view radius. In another embodiment, the radial distance

from the vehicle **600** that defines the "forward view radius" **640** is dynamically controlled depending on factors that comprise road density, traffic density, population density, user preferences and other factors that are relevant to real time traffic updates. In yet another embodiment, the radial distance from the vehicle **600** that defines the "forward view radius" **640** is controlled by road density. In one embodiment that controls the forward view radius, the forward view radius is shorter in an area with relatively high road density and the forward view radius is relatively longer in an area with relatively low road density. In another embodiment, the vehicle **600** incorporates a GPS unit **200** as described in FIG 2, and an MVCU **310** as described in FIG. 3.

In operation, when a traffic incident region GPS coordinate **520** is determined to be within the forward view radius **640** around the mobile vehicle communication unit based on the communicated traffic incident region coordinate data **520**, communication to a service provider is initiated requesting localized traffic incident data **525** for the traffic incident region to provide to a user.

FIG. 7 is a flow diagram of a method for providing real-time traffic updates to a mobile vehicle communication device. Method **700** commences with step **710**. In step **710**, traffic incident region coordinate data is produced. Traffic incident coordinate data may be produced at any time, and may continue indefinitely, repeat at predetermined intervals or repeat upon demand. In one embodiment, traffic incident data production is a continuous process that includes receiving traffic incident data, processing the traffic incident data to group traffic incidents into a plurality of traffic incident regions, and determining a traffic incident region GPS coordinate for each of the plurality of traffic incident regions. In one embodiment, the traffic incident region GPS coordinate **520** describes the geometric center of a traffic incident region **500** containing at least one traffic incident **525**. In another embodiment, the traffic incident region **500** is a geographical region of 10 square miles or less. In yet another embodiment, the traffic incident region **500** has a selectable geographical geometry based on

system MVCS **100** parameters such as system bandwidth, number of active subscription service subscribers, number of traffic incidents per-unit-time and other parameters.

In operation, a computer system **400** runs a program **476** to compile traffic incident reports **525** received through a variety of data channels and sources to create a database **475** of traffic incidents. The computer system **400** produces traffic incident region coordinate data **520** to be communicated in real-time simultaneously to traffic incident alert subscribers through a satellite broadcast system **140** over a very large geographic area, e.g., North America. In one embodiment, one or more data entry operators enter traffic incident data **525** into a database **475** in real-time for various geographic locations. Additional traffic incident data **525** may be received electronically from various sources such as, but not limited to, roadway sensors, GPS receivers **200**, and various municipal and police department computer systems. In one embodiment, program **476** compiles received traffic incident data **525**, processes the incident data **525** to group traffic incidents into a plurality of traffic incident regions **500**, **501**, **502**, and then determines a traffic incident region GPS coordinate **520** for each of the plurality of traffic incident regions **500**, **501**, **502**. In one embodiment, the program **476** is configured to sort the various traffic incident data **525** and group traffic incidents into traffic incident regions **520** of a selected geometry and size, with each region having a single GPS coordinate in order to reduce the amount of traffic incident data that must be broadcast to the MVCU **110** of a traffic incident alert service subscriber. Step **710** may continue indefinitely, repeat at predetermined intervals or repeat upon demand.

In step **720**, traffic incident region coordinate data is communicated to a mobile vehicle communication device **110**. Traffic incident region coordinate data **520** may be communicated at any time after it is produced in step **710**. In one embodiment, communicating traffic incident region coordinate data includes transmitting a traffic incident region GPS coordinate **520** for each of a plurality of traffic incident regions **500** and subsequently receiving the traffic incident region GPS coordinates **520** for each of the plurality of traffic incident regions **500** at a mobile vehicle communication device. In another embodiment, the traffic incident region coordinate data **520** is communicated through a wireless communications system **120** such as satellite broadcasting systems **140** and radio carrier systems **130**, for example. Once initiated, step **720** may continue indefinitely, repeat at predetermined intervals or repeat upon demand.

Step **730** comprises determining when a traffic incident region coordinate **520** is within a predetermined radius around a mobile vehicle communication device based on the traffic incident region coordinate data **520** received in step **720**. In one embodiment, step **730** is a continuous "do until" process that automatically monitors traffic incident region coordinate data **520** received to a mobile vehicle communication device until GPS coordinates **520** within a "forward view radius" **640** are identified, at which point a secondary process is invoked while the GPS coordinate monitoring continues. In one embodiment, determining when a traffic incident region coordinate **520** is within a predetermined radius **640** around a mobile vehicle communication device includes determining a location GPS coordinate describing the location of the mobile vehicle communication device, comparing the received traffic incident region GPS coordinate **520** with the location GPS coordinate describing the location of the mobile vehicle communication device, and identifying when a traffic incident region GPS coordinate **520** is within the predetermined radius **640** around the mobile vehicle communication device based on the comparison. In one embodiment, a GPS receiver **200** is utilized with an MVCS **310** in a vehicle

600 to determine a location GPS coordinate and to receive vehicle traffic incident region coordinates and to compare the location GPS coordinate with received coordinates to identify a traffic incident region GPS coordinate **520** within the predetermined forward view radius of vehicle **640**.

Another embodiment further includes determining localized traffic incident data **525** for the traffic incident region coordinate **520** responsive to determining that the traffic incident region coordinate **520** is within a forward view radius **640** of the mobile vehicle communication device. In yet another embodiment, determining localized traffic incident data **525** includes initiating a communication to a service provider, requesting the localized traffic incident data **525** for the determined traffic incident region coordinate **520** from the service provider, receiving the traffic incident data **525** for the traffic incident region coordinate **520** from the service provider, and providing the localized traffic incident data **525** to a user. Localized traffic incident data **525** includes any traffic incident reports for a geographic traffic incident region **500** for which a single GPS coordinate **520** was created. In one embodiment, the localized traffic incident data **525** is provided to a display device. In another embodiment, the localized traffic data **525** is provided to an audio device such as a speaker. In yet another embodiment, localized traffic data **525** is provided by a live operator through a service provider channel, such as the OnStar ® system for example. Step **730** may continue indefinitely, repeat at predetermined intervals or repeat upon demand.

FIG. 8 is a process flow diagram in an example of the method of FIG. 7 according to an embodiment of the invention. Process **800** begins in step **810** with the grouping of received traffic data into “areas”, or “regions” as described with reference to FIG. 7. Step **810** is a continuous process that includes receiving traffic incident data, processing the traffic incident data to group traffic incidents into a plurality of traffic incident regions, and determining a traffic incident region GPS coordinate for each of the plurality of traffic incident regions. A computer system **400** runs a program **476** to compile traffic incident reports **525** received

through a variety of data channels and sources to create a database **475** of traffic incidents (traffic data). Traffic incident data **525** may be received electronically from various sources such as roadway sensors, GPS receivers, and various municipal and police department computer systems. The computer system **400** produces traffic incident region coordinate data **520** representing the areas of grouped traffic incidents in response to the received traffic incident reports.

In step **820**, GPS coordinates for the traffic incident regions are transmitted through a satellite broadcast system **140** over a very large geographic area, e.g., North America, to be received at a mobile vehicle communication device **110**. Once initiated, step **820** may continue indefinitely, repeat at predetermined intervals or repeat upon demand.

In step **830** a radio receiver (MVCU **110**) in a vehicle monitors the satellite radio transmission of step **820** to determine when a GPS coordinate is within a "forward view" radius around the vehicle.

In step **840**, the receiver determines when a received GPS coordinate is detected that describes a location within the vehicle forward view. A GPS receiver **200** is utilized with an MVCS **310** in a vehicle **600** to determine a vehicle location GPS coordinate and to receive vehicle traffic incident region coordinates and to compare the location GPS coordinate with received coordinates to identify a traffic incident region GPS coordinate **520** within the forward view radius of the vehicle **640**.

In step **850**, a determination is made whether a new GPS coordinate representing a new area is received. If the determination in step **850** is affirmative, process **800** continues to step **860**. If the determination in step **850** is negative, then process **800** returns to step **830**. In step **860**, the receiver in the vehicle confirms that a received GPS coordinate is detected within the vehicle forward view. In step **870**, a wireless telephone call is placed to a service provider call center, such as the OnStar ® call center, to obtain detailed traffic

incident data for the area represented by the GPS coordinate received by the receiver in the vehicle. The detailed local traffic data is then provided by the service provider to the vehicle receiver during the telephone call.

In step **880**, a determination is made whether the vehicle support visual display of the local traffic data received in step **870**. If the determination in step **880** is affirmative, the received local traffic data is provided to a visual display in step **890** and process **800** returns to step **830**. If the determination in step 880 is negative, then the received local traffic data is provided to an audio device in step **895** and process **800** returns to step **830**.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive.